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Lowering Cholesterol: through the use of Plant Sterols and Stanols

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Lowering Cholesterol: through the use of Plant Sterols and Stanols

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Lowering Cholesterol: through the use of Plant Sterols and Stanols

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I. Abstract

Heart disease has been the number one killer of American men and women over the past hundred years, with high blood cholesterol as a major risk factor of this disease. High Cholesterol can be a result of a number of different lifestyle choices such as diet and exercise. However, genetics and family history also play a role in the levels of cholesterol in the human body. Those who have high blood cholesterol levels are usually advised by their health professionals to consume a diet low in saturated fats and cholesterol, high in fiber and to exercise frequently. However, sometimes these precautions are just not enough to lower cholesterol to healthy levels, thus supplemental measures need to be taken.

Cholesterol lowering medicines and/or adding plant sterols to a diet is a good complementary measure to take in order to lower cholesterol in individuals. People consume plant sterols and stanols every day in the foods they eat, however the amount that they consume is often not great enough to provide significant blood-cholesterol lowering effects.

My senior research project will involve studying the natural and healthy alternatives to lowering individuals' blood-cholesterol through plant sterols and stanols. Food technologies have allowed plant sterols and stanols to be naturally incorporated into many commercially modified foods (such as salad dressings, spreads, yogurts, juices, snack bars etc.). These products containing plant sterols and stanols have been approved by the FDA to label health claims about their effectiveness in reducing the risk of coronary heart disease.

I will explain in my research paper, the cholesterol lowering effects of plant sterols and stanols and the food technologies that have been created with these natural components.

II. Introduction

The number one killer of both men and women in the United States over the past century has been heart disease, with high blood cholesterol as a major risk factor of this disease. Over a million Americans experience heart attacks each year and about half million people die from the disease that causes them.¹ One out of every three Americans die each year (2,400 Americans die each day and one death every 37 seconds) due to some form of cardiovascular disease, which surpasses the number of deaths each year due to cancer.² Since high cholesterol in individuals is proven to be one of the main risk factors for cardiovascular disease, I wanted to investigate more about the constructive measures that can be taken to reduce individuals risks for this disease. With all of the different medications and prescription drugs on the market today, I thought it would be interesting to research the alternative methods of lowering cholesterol the natural way- through the use of plant sterols and stanols.

A. Methods

For my honors project, I engaged in both primary and secondary research methods in order to obtain data on cholesterol, plant sterols and heart disease in individuals. The primary research that I conducted involved distributing surveys about cholesterol awareness to individuals, with questions about family history, diet, exercise, and saturated and trans fats (see *Survey Results* section for actual survey). I surveyed a total of sixty individuals (thirty males, and thirty females) with an even distribution of males and females in each age group: 19-29, 30-49, and 50 and over. These individuals (most

¹“National Institutes of Health.” June 2005. 3 November 2007
<http://www.nhlbi.nih.gov/health/public/heart/choh/wyntk.htm>.

²“Heart Disease and Stroke Statistics-2006 Update.” 2006. 3 November 2007.
<http://circ.ahajournals.org/cgi/content/full/113/6/e85#SEC2>.

were students and professors) were randomly selected from the University of Rhode Island, from a variety of different academic programs and disciplines (Biology, Business, History, Fashion, Nutrition, English, etc.). The results of this survey can be found in the *Survey Results* section of this paper.

The secondary research I conducted focused primarily on literature studies that have been completed by PhD students and other scientific researchers involving plant sterols and their effects on cholesterol. The American Heart Association (AHA), Food and Drug Administration (FDA), International Food Information Council (IFIC) and Journal of the American College of Nutrition were very useful sources from which I obtained most of my research and data for this project.

III. Background

A. Plant Sterols and Stanols

Plant sterols are found naturally in many fruits, vegetables, nuts, seeds, legumes, vegetable oils and other plant sources. Plant stanols are found in the same sources, just in smaller amounts. Sterols and stanols are important elements of plant cell membranes and resemble cholesterol in a structural form.³ More than 200 sterols and stanols have been found in plants with beta sitosterol, stigmasterol, and campesterol most abundant in sterols and sitostanol and campestanol most abundant in stanols. Approximately 50% of dietary cholesterol is absorbed from the intestinal tract, where phytosterols such as: campesterols/stanols are absorbed at 10-15%, 4-7% for sisterol and less than 1% for sitostanols. A typical diet in western populations provides about 150-400 mg/day of phytosterols and phytostanols from the ingestion of vegetable oils, cereals, vegetables, and fruits. The majority of this intake is considered to be plant sterols, accounting for about 150-350 mg/day, where plant stanols only account for about 15-50 mg/day.⁴

Plant sterols were first noticed for their cholesterol lowering effects in the 1950's, when they were taken from vegetable fats/oils and pine trees and analyzed for their effectiveness. Plant sterol and stanols work to lower cholesterol by slowing its intestinal absorption. As mentioned above, sterol and stanols structurally resemble cholesterol, thus

³ "Functional Foods Fact Sheet: Plant Stanols and Sterols." April 2003. 21 October 2007.
<http://www.ific.org/publications/factsheets/sterolfs.cfm>.

⁴ Stipanuk, Martha H. Biochemical Physiological and Molecular Aspects of Human Nutrition. Saunders Publisher. 2nd Edition. Pp.24-25. 2006.

it interferes with cholesterol loading into the mixed micelles (submicroscopic aggregation of molecules), and as a result, less cholesterol is absorbed by the body.⁵

In multiple studies performed, reviewing 41 trials and in another study, 50 trials, it was concluded by both studies that on average, intake of 1.5-2.0 g/day of stanol and sterols decreased LDL (bad cholesterol) by 10%. Both studies similarly concluded that ingesting more than 2 grams of plant sterols and stanols a day did not add any greater benefits of lowering a greater percentage of cholesterol.⁶

Another study was conducted involving the effectiveness of plant sterols and stanols added to individuals diets, who were either already on a heart-healthy diet or on a cholesterol lowering medication. Patients in this study following the *National Cholesterol Education Program (NCEP)* diet alone were given 2.3 g/day of stanols to their diets. These patients were shown to have decreased levels of total cholesterol by 8-11% and a 4-14% decrease in LDL cholesterol levels.⁷

**No unfavorable side effects were encountered with the ingestion of plant stanol or sterols in these studies.*

Although plant sterols prove to effectively lower blood cholesterol in individuals with elevated levels of LDL cholesterol, it is intended for those people who need or want to lower their cholesterol. The American Heart Association (AHA) suggests that individuals, who are on cholesterol lowering medication already, should consult their

⁵Stipanuk. Pp. 24-25. 2006.

⁶ Katan MB et al. "Efficacy and safety of plant stanols and sterols in the management of blood cholesterol levels." August 2003. 1 Nov 2007.

⁷Stipanuk. p 25. 2006.

doctor about consuming plant sterol products and it is suggested that plant sterol products may not be appropriate for children of pregnant women who are breast-feeding. Children (besides those with familial hypercholesterolaemia) and lactating or pregnant women do not need plant sterol products because it is not necessary to reduce blood cholesterol in these situations.⁸ The AHA also notes that no studies have shown long term heart benefits and individuals should continue basic diet and lifestyle changes throughout the years. The British heart foundation has agreed with the AHA, stating that plant sterols help to control cholesterol levels, but it is also important for people to eat a lot of fruits and vegetables, increase their activity and stop smoking in order to reduce their overall risk of coronary heart disease.⁹

B. Cholesterol

Cholesterol is a waxy substance in the blood plasma and in animal tissues. It is an organic compound (C₂₇H₄₆O) in the steroid family and it is a white, crystalline substance that is odorless and tasteless in its pure state. Cholesterol is the most abundant sterol in animals; it is synthesized by the liver and consumed through diet. Cholesterol is essential for life, serving as a building block for steroid hormones (testosterone and estrogen), and for cell walls.¹⁰ However, cholesterol is not required in the diet because the body can synthesize all it needs for essential functions.

⁸ "Phytosterol/sterol enriched foods." National Heart Foundation of Australia. August 2007. 17 December 2007. http://www.heartfoundation.org.au/document/NHF/HF_Phytosterol_Stanol_QA_General_2007_Aug_FINAL.pdf

⁹ "Do we need to be buying plant sterols?" *Food Magazine*, p 67. Oct/Dec 2004.

¹⁰ "Functional Food Fact Sheet." April 2003. 2 October 2007.

<http://www.ific.org/publications/factsheet/sterols/cfm>

A high level of cholesterol in the blood is a major risk for developing coronary heart disease which leads to heart attacks. In order for individuals to check their cholesterol, they must get a blood test done to measure their total cholesterol to determine if it is high or low. It is recommended that our total cholesterol be under 200 mg/dL and anything over this number would be considered too high.¹¹ Cholesterol as well as other fats are not able to dissolve in blood, thus they are transported to cells by carriers called lipoproteins. Two main types of lipoproteins are low-density lipoprotein (LDL) and high density lipoprotein (HDL).

LDL cholesterol, also known as “bad cholesterol”, is the major cholesterol carrier in the blood and if too much of this is present in the blood, it slowly builds up in the walls of the arteries that feed the heart and brain. LDL cholesterol can also combine with other substances to form plaque (thick hard deposit that clogs arteries) and block the flow of blood to parts of the heart and brain (also known as atherosclerosis). If a clot forms near this plaque, it can block the blood flow to the heart, causing the heart to get insufficient amounts of oxygen-rich blood and cause a heart attack. The higher the level of LDL cholesterol in the blood, the worse; a level of 160 mg/dL or higher considered dangerous and puts the individual at an increased risk for heart disease. In an individual with heart disease, is suggested that their LDL cholesterol level be less than 100 mg/dL.

HDL cholesterol (good cholesterol) on the other hand, carries about one forth blood cholesterol and works to carry it away from arteries and back to the liver to be excreted

¹¹ “Cholesterol Management Health Center.” 26 August 2005. 25 October 2007.
<http://www.webmd.com/cholesterol-management/>

from the body. High levels of HDL cholesterol are thought to remove excess cholesterol, slowing the growth of plaque, thus protecting against heart attack. A level of 60 mg/dL or higher of HDL cholesterol is considered to be good and protect against heart disease, and HDL level below 40 mg/dL is considered to be bad.¹²

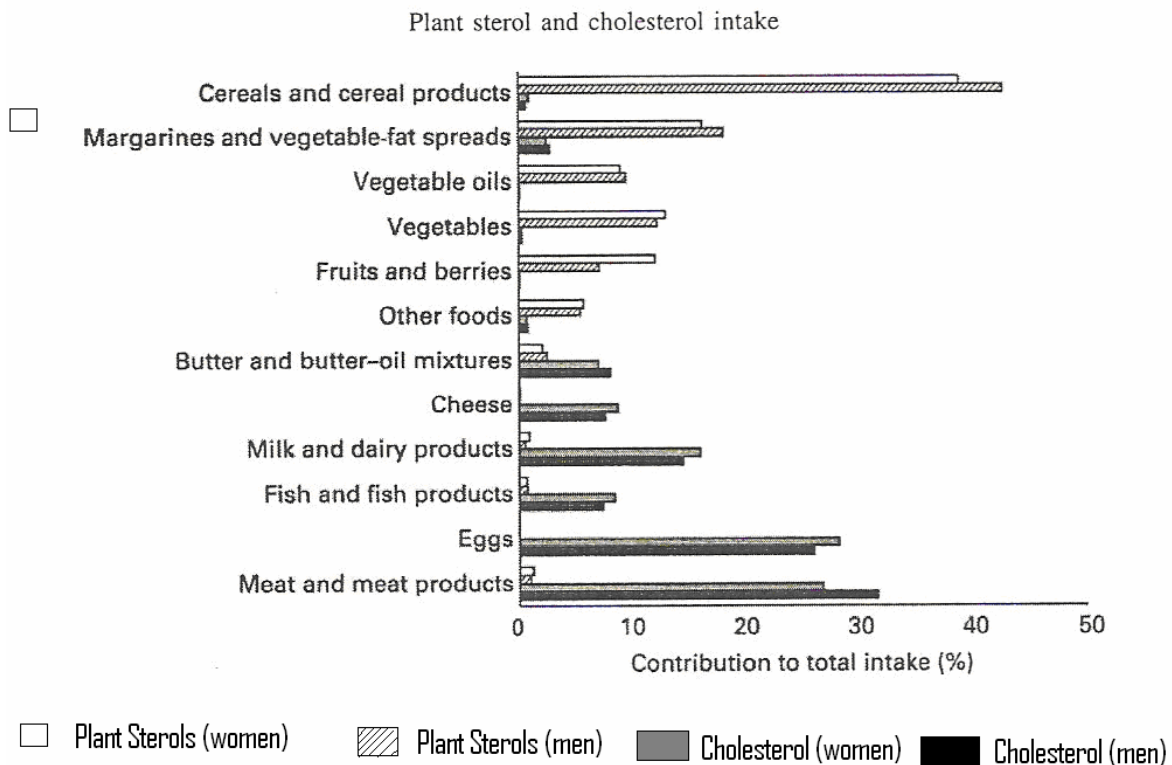
C. Diet

As mentioned above, our body gets cholesterol through our liver, naturally producing around 1,000 mg/day, and through our diet. Some foods containing cholesterol are foods from animals such as: egg yolks, meat, poultry, shellfish and whole milk and other dairy products. Foods that we consume from plants, such as: fruits, vegetables, seeds, nuts and grains do not contain cholesterol. Consuming foods high in saturated fats, trans fats and even dietary cholesterol raises blood cholesterol levels, which in turn increases the risk of heart disease. The chart below shows certain food groups as sources of plant sterols and cholesterol in men and women in a Finland diet study that took place in 1997.¹³ This chart indicates that cereals and cereal products were main sources for plant sterols, followed by margarines and vegetable-fat spreads. The average cholesterol intake was 284 mg/d for men and 201 mg/d for women (diet did not differ between men and women). The main sources for cholesterol are indicated in the lower portion of the graph as eggs, meat and meats products.

¹² "Cholesterol." 2007. Accessed 6 Nov 2007.

<http://www.americanheart.org/presenter.jhtml?identifier=4488>

¹³ Valsta, L.M. et al. British Journal of Nutrition. 92. Pp. 671-678. 2004



It is recommended by the American Heart Association (AHA) to consume less than 300 mg/day of cholesterol and 200 mg/day if you currently have heart disease. The average American man consumes around 337 mg/day of cholesterol, and the average women consumes 217 mg/day. To maintain a healthy level of cholesterol, the AHA suggests that intake of lean meat should be limited to no more than 6 oz a day and to use low-fat and fat-free dairy products. A good substitute for animal sources of protein are foods such as vegetables and beans.¹⁴

Studies from the Mayo Clinic suggest that walnuts, almonds, fish and omega-3 fatty acids can lower blood cholesterol. Walnuts, being rich in polyunsaturated fatty acids, help to

¹⁴ "What about Cholesterol and Diet?" 2007. 6 November 2007.
<http://www.americanheart.org/presenter.jhtml?identifier=4488>

keep blood vessels healthy and elastic. They were also shown to reduce LDL cholesterol by 12% when 20% of one's diet comes from walnuts in a given day (for a 1,200 calorie diet, 1/3 cup of walnuts is about 20% or 240 calories). Almonds were shown to have similar effects, improving cholesterol levels in only four weeks. It is important to note, however that nuts are high in calories, so limiting their intake to about a 1/3 cup is a reasonable amount. Eating too much of anything can cause weight gain and put a person at a greater risk of heart disease. Fish and omega-3 fatty acids can also be recognized for their heart healthy contributions. Omega-3 fatty acids can be found in fish, whale and seal meat as well as walnuts, flaxseed oil, canola oil and soybean oil. These fatty acids are known to reduce blood pressure and the risk of blood clots. The Mayo Clinic suggests eating two servings of fish a week and to bake or grill the fish in order to receive the most heart healthy benefits.¹⁵ A modification in diet therapy is the key to lowering total cholesterol, LDL concentrations and the risk of cardiovascular disease.¹⁶

i. Fiber

Fiber is made up of components of a plant cell wall (cellulose, hemicellulose, pectin, lignin, etc.) and is not digestible by humans or other mammals. The only way fiber can be degraded is by anaerobic bacteria in the large intestine. Fiber rich foods also contain

¹⁵ "Cholesterol: The best foods to lower your cholesterol and protect your heart." 10 May 2006. 12 November 2007. <http://www.mayoclinic.com/health/cholesterol/CL00002>

¹⁶ Moruisi, Kgomotso G, et al. "Phytosterols/Stanoles Lower Cholesterol Concentrations in Familial Hypercholesterolemia Subjects." Journal of the American College of Nutrition. Vol 25.no.1. P 46. 2006.

vitamins, minerals, antioxidants, and other chemicals that are beneficial to health. There are two classifications of fiber: soluble and insoluble.¹⁷

Soluble fiber reduces the absorption of cholesterol in the intestines and binds bile (contains cholesterol) and dietary cholesterol so that it is excreted by the body. Soluble fiber can be found in foods such as: kidney beans, Brussels sprouts, apples, pears, barley and prunes. Oatmeal and oat bran also contain soluble fiber, which reduces LDL cholesterol. About 5-10 grams of soluble fiber a day decreases LDL cholesterol by about 5%.¹⁸ The FDA is now allowing companies to advertise their products' cholesterol lowering effect (i.e. oatmeal). Soluble fiber is also thought to reduce levels of a C-reactive protein, which has been linked to cardiovascular disease, diabetes, and cancer.¹⁹

Insoluble fiber, on the other hand decreases individual's cardiovascular risk and slows cardiovascular disease in those who are at high-risk for the disease. Another benefit of insoluble fiber is that it slows gastric emptying, which may allow individuals to feel full longer and decrease overall calorie intake. Foods that are high in insoluble fiber are whole-wheat breads, cereals, bran, rye, barley, cabbage, beets, carrots and turnips.²⁰ It is recommended that adults consume 21-38 grams of fiber per day (depending on age and gender), yet the average American consumes only about 15 grams/day of fiber.²¹

¹⁷ "Definition of dietary fiber." 10 December 2007. 11 December 2007.

<http://www.dietaryfiberfood.com/dietary-fiber.php>

¹⁸ "Cholesterol: The best foods to lower your cholesterol and protect your heart." 10 May 2006. 12 November 2007. <http://www.mayoclinic.com/health/cholesterol/CL00002>

¹⁹ "Dietary Fiber is Still in Style." March/April 1999. 17 December 2007. <http://www.ific.org/foodinsight/1999/ma/fiberfi299.cfm>

²⁰ "What is dietary fiber?" 2007. 2 December 2007.

<http://www.americanheart.org/presenter.jhtml?identifier=4574>

²¹ "Start Roughing it!" 2007. 30 October 2007. <http://www.hsph.harvard.edu/nutritionsource/fiber.html>.

D. Physical Activity and Exercise

Exercising and getting enough regular physical activity is essential in keeping the heart healthy and can increase HDL (good) cholesterol in the body. As mentioned earlier, the higher HDL in an individual the better and the lower risk of heart disease they are exposed to. Getting an adequate amount of physical activity is important for other reasons as well, such as helping control weight, diabetes and high blood pressure. Exercising raises your heart and breathing rates, which conditions the heart and lungs to work more efficiently.²² The American Heart Association recommends aiming for at least 30 minutes of moderate intensity cardiovascular exercise five days a week for healthy people between the ages of 18-65. This minimal amount of exercise a day will help to keep the heart functioning more efficiently even at rest and improving overall endurance.²³

E. Family History

Heart disease and fatty build up in the arteries result in part from heredity. With that said, children who have parents with heart or blood disease would be more likely to develop one of the two. Race is another influencing hereditary of heart disease; African

²² "How does physical activity affect cholesterol?" 2007. 2 December 2007.
<http://www.americanheart.org/presenter.jhtml?identifier=4488>

²³ "Exercise and Fitness." 17 October 2007. 17 December 2007.
<http://www.americanheart.org/presenter.jhtml?identifier=1200013>

Americans have a higher risk of developing high blood pressure, thus exposing them to a greater risk of heart disease.²⁴

Familial hypercholesterolemia (FH), which is a genetic disorder characterized by high LDL cholesterol as a result of a mutation in the low-density lipoprotein receptor. FH also can cause early cardiovascular disease to run in families. Treatment of FH in individuals usually involves a cholesterol lowering diet and statin (prescription drug used to lower cholesterol) use. These are generally the measures taken to lower cholesterol in adults, for children with high cholesterol, diet modification is suggested.²⁵

In a study from PhD students at North-West University's School of Physiology in South Africa, graduate students researched the incorporation of plant sterols/stanols in the diet of FH patients to determine if they would efficiently lower LDL cholesterol levels in these individuals. Nineteen randomized controlled trials were conducted, giving the individuals 1.5-3 g/day of plant sterols incorporated in different foods such as: margarine/fat spreads, butter, salad dressings, mayonnaise, low fat yogurt, etc. The study concluded that the food containing plant sterol/stanols given to the FH participants in the study had significantly reduced LDL levels between 8%-15%. This study also concluded that 2 g/day plant sterol/stanols effectively lower an individual's LDL cholesterol.²²

Below is a chart that summarizes the results of the study conducted on the effects of

²⁴ "Heredity as a Risk Factor." 2007. 2 December 2007.

<http://www.americanheart.org/presenter.jhtml?identifier=4610>

²⁵ Moruosi, Kgomo G, et al. "Phytosterols/Stanoles Lower Cholesterol Concentrations in Familial Hypercholesterolemia Subjects." Journal of the American College of Nutrition. Vol 25.no.1. pp.41-42. 2006.

phytosterol/stanol's effects on lowering total cholesterol and LDL levels in FH individuals.

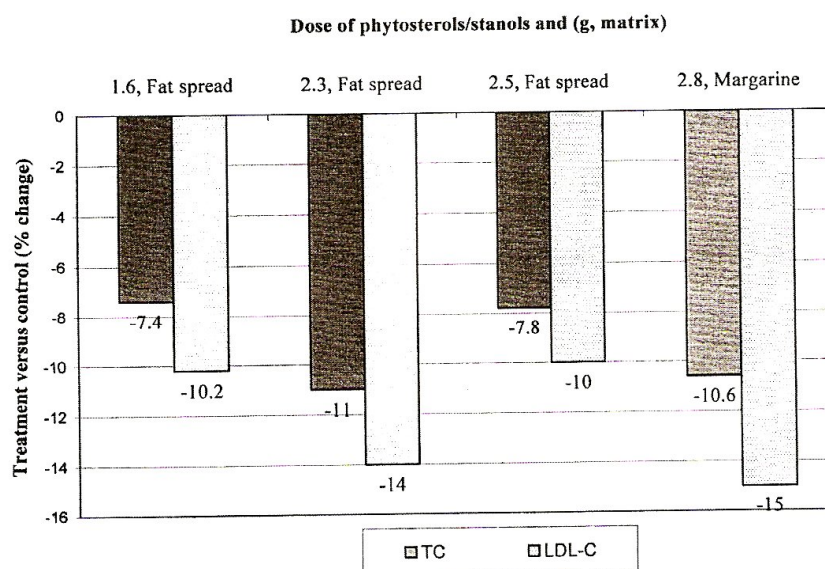


Fig. 2. Effect of phytosterol/stanol versus control on TC and LDL-C concentrations in familial hypercholesterolemic subjects. LDL-C = low-density lipoprotein cholesterol, TC = total cholesterol.

Most all FH individuals need to reduce their LDL levels by more than 40% in order to reach normal levels of LDL cholesterol in the body. Thus, phytosterol/stanols should be taken in addition to a healthy lifestyle, a low-cholesterol diet and perhaps cholesterol lowering drugs. Overall, plant sterol/stanols are proven to reduce the risk of coronary heart disease in FH individuals. This study also reported no or minor side effects (gastrointestinal side effects, abdominal discomfort, diarrhea and constipation) when giving a larger amount of plant sterols/stanols to subjects (these side effects were not reported to be long term). Plant sterol/stanol products were also proven to be safe for both children and adults with FH. The effects of LDL concentrations with the intake of plant sterols/stanols were found to be reduced by 10% and 14% with sterols and 15%

with plant stanols (refer to graph). Thus, the graduate students conducting this study concluded that plant stanols may be preferable for long-term management of hypercholesterolemia.²⁶

²⁶ Moruosi, Kgomo G. et al. Journal of the American College of Nutrition. Vol 25.no.1 pp.45-46. 2006.

IV. Statins

A study was conducted on hypercholesterolemia (higher levels of cholesterol in the blood) in individuals taking statins (cholesterol lowering medication) to determine if sterols and stanols would have an additional effect on lowering cholesterol in the blood. Participants in this study were given 3 g/day of stanols, resulting in a 10% reduction in LDL cholesterol compared to hypercholesterolemic individuals on statins alone. When individuals taking a normal dose of a statin medication were given a double dose, their LDL cholesterol only decreased 6%. Thus, this study concludes that it is more beneficial for an individual taking a statin medication to take about 3g/day stanols rather than doubling their statin dose.²⁷

In an interview with Dr. Ingrid Lofgren, a professor specializing in lowering blood lipids at the University of Rhode Island, she notes:

*“I think statin medications are necessary for some people. Some people are able to lower their LDL by 10-15% by the use of diet and exercise and their LDL level could top off there. You can advise people to exercise more and change their diet, but the reality is some people won’t make those changes. Sometimes, statin drugs are absolutely necessary.”*²⁸

Statins are one of the most effective drugs for lowering LDL cholesterol levels in individuals and lower the risk of cardiovascular disease. They help to block a substance in your liver that is needed to make cholesterol and help your body reabsorb cholesterol that has accumulated on your artery walls.²⁹ The measurement of an individual’s cholesterol, family history, lifestyle, blood

²⁷ Stipanuk. P 25. 2006

²⁸ Lofgren, Ingrid. Interview. 8 November 2007.

²⁹ “Cholesterol Medication.” 2007. 3 December 2007.

<http://www.americanheart.org/presenter.jhtml?identifier=3044771>

pressure, age, general health, presence of diabetes, excess weight, smoking and cardiovascular risk over the next 10 years are all factors that are considered when determining if an individual should be placed on a statin medication. Statins include medications such as: atorvastatin (Lipitor), simvastatin (Zocor), lovastatin (Mevacor), pravastatin (Pravachol), rosuvastatin (Crestor) and others. Most statins' side effects are mild, however can be serious and even deadly. Some side effects include: muscle aches and pains, abdominal pains, gas, constipation, cramps, muscle soreness and weakness (myopathy) and liver and kidney abnormalities. In 2001, Bayer Pharmaceuticals recalled its statin drug Baycol, which was eliminated from the market due to many incidences of rhabdomyolysis (rapid breakdown of skeletal muscle tissue).

“Company executives felt constrained to take this radical move because an analysis of new data showed that 31 patients taking Baycol had died from a severe muscle disorder called rhabdomyolysis. Of the 31 people who died from Baycol-induced rhabdomyolysis, 12 were also taking gemfibrozil, another lipid-lowering agent. It has been known for some time that using statins in combination with gemfibrozil can make muscle problems more likely to occur, and the warning labeling for statin drugs have reflected this fact. In the remaining 19 patients who died taking Baycol, it has been reported that the large majority were started directly on the highest dose of the drug.”³⁰

Pharmaceutical statin medications are very important because some individuals are simply not able to lower their cholesterol through lifestyle changes such as diet and exercise. Since every individual is different, what works for one person may not work for another. One person can make significant diet modifications, and see no change in their cholesterol levels, where some people see a huge decrease in LDL cholesterol levels after

³⁰ “The Baycol Recall-what it means.” 13 August 2001. 3 September 2007.
<http://heartdisease.about.com/library/weekly/aa081301a.htm>

cutting out excess calories and saturated and trans fats from their diet. Dr. Schaefer (MD, a heart disease researcher at Tufts-New England Medical Center) suggests that diet, exercise and medication are not mutually exclusive and people should take advantage of both diet and drugs if their doctor prescribes them to a statin drug after they gave the lifestyle change an honest effort. Dr. Schaefer also notes, that lifestyle changes are very important, people on terrible diets have had cholesterol levels that were difficult to control even with statins, even though those drugs are very effective.³¹

³¹ Schaefer, Ernst. "Was the Statin Prescription Right in the First Place?" Health and Nutrition Newsletter, Tufts University. August 2003. 8 Dec 2007. <http://healthletter.tufts.edu/issues/2003-08/statin.html>

V. Food and Drug Administration

The Food and Drug Administration has authorized labeling food products containing plant sterols and stanols with health claims that they contribute to reducing the risk of coronary heart disease (CHD) by lowering blood cholesterol levels. The FDA supports this new health claim based on evidence in studies proving that plant sterols or plant stanols may reduce the risk of CHD.

“Foods that carry the claim must also meet the requirements for low saturated fat and low cholesterol, and must also contain no more than 13 grams of total fat per serving and per 50 grams. However, spreads and salad dressings are not required to meet the limit for total fat per 50 grams if the label of the food bears a disclosure statement referring consumers to the Nutrition Facts section of the label for information about fat content. In addition, except for salad dressing and dietary supplements, the food must contain at least 10% of the Reference Daily Intake (RDI) or Daily Reference Value (DRV) for vitamin A, vitamin C, iron, calcium, protein, or fiber. FDA is also requiring, consistent with other health claims to reduce the risk of CHD, that the claim state that plant sterol and plant stanol esters should be consumed as part of a diet low in saturated fat and cholesterol. The claim must specify that the daily dietary intake of plant sterol esters or plant stanol esters should be consumed in two servings eaten at different times of the day with other foods. An example of a health claim about the relationship between plant stanol esters and reduced risk of heart disease is:

Diets low in saturated fat and cholesterol that include two servings of foods that provide a daily total of at least 3.4 grams of plant stanol esters in two meals may reduce the risk of heart disease. A serving of [name of the food] supplies ____ grams of plant stanol esters.

This new health claim interim final rule responds to petitions submitted to the FDA by Lipton (plant sterol esters) and McNeil Consumer Healthcare (plant stanol esters). The FDA is issuing this rule as an interim final rule. It is effective immediately with an opportunity for the public to comment. The final rule on this health claim may differ from this interim rule, and manufacturers would be required to revise their labeling to conform to any changes adopted in the final rule. Written comments will be received until 75 days after date of publication in the Federal Register and may be addressed to: Dockets Management Branch (HFA-305), Food and Drug Administration, 5630 Fishers Lane, Rm. 1061, Rockville, MD 20852.”³²

³² “FDA Authorizes new coronary heart disease health claim for plant sterols and plant stanol esters.” 5 Sept 2000. 29 October 2007. <http://www.fda.gov/bbs/topics/ANSWERS/ANS01033.html>

VI. Products Containing Plant Sterols

As mentioned above, plant sterols can be consumed naturally by the ingestion of fruits, vegetables, grains etc. However, it is difficult to know how much sterols an individual is actually consuming a day and if they are consuming enough plant sterols to lower their cholesterol on a daily basis through consuming these natural foods. Thus, food companies have implemented food technologies and found ways to incorporate plant sterols and stanols into food products so individuals can monitor how much plant sterols and/or stanols they are actually consuming a day. Companies such as Unilever (Promise), GNC, General Mills and Coca Cola have all developed products adding these natural plant ingredients to make it easier for people to lower their cholesterol, by blocking the absorption of cholesterol in the body.

Unilever North America has created Promise active SuperShots, which are fruit and yogurt mini-drinks containing plant sterols, and are clinically proven to reduce cholesterol as part of a diet low in saturated fat. Unilever says, “Plant-sterol containing food should be used twice a day with meals. But it would take about 100 lbs. of fruits, vegetables and nuts to get the 2g of plant sterols found in these SuperShots. These SuperShots can be found in strawberry, peach and raspberry and provide additional health benefits, such as omega-3 fatty acids and a good source of vitamin E.” Unilever also states that, “this new product innovation is an example of Unilever’s commitment to helping people maintain a healthy heart and to stay healthy for longer.”³³

³³ “Rollout: September’s best new products.” September 2007. 31 October 2007.
<http://www.foodprocessing.com/articles/2007/219.html>

Yoplait (brand of General Mills) also came out with a heart healthy yogurt, containing plant sterols that are proven to lower cholesterol. “It’s the first yogurt available in the U.S. that contains cholesterol-lowering plant sterols, clinically proven cholesterol reducers. While results vary by individual, studies have shown that eating 0.8 g of plant sterols—the amount found in two servings of Yoplait Healthy Heart—each day over a period of as little as four weeks may reduce LDL by an average of 6%.”³⁴

Plant sterols can be added to a variety of food products, including margarine, salad dressings, yogurts and others. Research has shown that there has been no adverse effect on taste or texture of these products in foods such as orange juice, cheese and dairy substitutes.³⁵

In an interview I conducted with program leader of the nutrition research department from Kraft, Inc. Kristin Herron Rubin PhD. notes:

*“Whenever you want to incorporate ingredients into a product, it is important to consider how much calories, and fat you are adding and if it’s going to taste good. No one is going to want to buy a product that doesn’t taste good.”*³⁶

In another study involving patients who consumed plant sterols it was further concluded that some of the spreads (i.e. margarine, fat spreads) did not taste differently, due to the 92%-97% compliance reports on the three compliance on fat spreads reports that were taken.³⁷

³⁴ “Rollout: The best of April’s new food products.” April 2005. 31 October 2007. <http://www.foodprocessing.com/articles/2005/291.html>

³⁵ “Foods Enriched with Plant Sterols.” 2007. 2 December 2007. <http://www.corowise.com/fastfacts.html>

³⁶ Herron- Rubin, Kristin, Interview 10 Nov 2007.

³⁷ Moruisi, Kgomotso G. et al. Journal of the American College of Nutrition. Vol 25. no 1.P 46. 2006.

In consuming plant sterols in these new products, enhanced with food technology, it is important to also consider what else is being added to your body (calories, fat, saturated fat, etc.). The chart below gives a breakdown of the Promise products containing plant sterols and their nutritional facts. As you can see, these Promise products (Promise active SuperShots, Promise active Buttery Spread and Promise active Light Spread) all contain a significant amount more of plant sterols with less saturated fat and half the calories of most other foods containing plant sterols.³⁸ There is clearly a benefit in consuming products with plant sterols in lowering cholesterol, fat and calorie intake by substituting this product over 1 oz of almonds or eating one small avocado.

DIETARY SOURCE	SERVING SIZE	CALORIES	FAT	SAT. FAT	TRANS FAT	PLANT STEROLS**
Promise activ™ SuperShots™	3 oz. bottle	70	3.5 g	0 g	0 g	2.0 g
Promise activ™ Buttery Spread* (formerly known as Take Control®)	1 Tbsp	80	8 g	1 g	0 g	1.0 g**
Promise activ™ Light Spread* (formerly known as Take Control®)	1 Tbsp	45	5 g	1 g	0 g	1.0 g**
Almonds	1 oz.	164	14 g	3.8 g	0 g	0.03 g
Avocados	1 small	227	20 g	2.9	0 g	0.13 g
Corn Oil	1 Tbsp	120	13 g	1.8 g	0 g	0.13 g
Olive Oil	1 Tbsp	119	13.5 g	1.9 g	0 g	0.03 g
Orange Juice with plant sterols	8 oz.	110	0 g	0 g	0 g	1.0 g+
Oat Bars with plant sterols	1 bar	160	4 g	0.5 g	0 g	0.4 g

USDA Nutrient Database unless otherwise specified.

³⁸ “The Power of Natural Plant Sterols.” 2007. 23 September 2007.
<http://www.webmd.com/content/article/134/119063.htm>

For individuals who have normal levels of blood cholesterol, not much is gained from consuming plant sterol products. A diet healthy with fruits, vegetables, grains, nuts, beans and seeds will provide a plentiful amount of plant sterols for these individuals. Below is a chart of some natural foods that can be consumed that are rich in plant sterols.

39

Some foods naturally rich in plant sterols (per 100 grams of the food)	
Avocado	80mg
Walnuts	70mg
Almonds	120mg
Soya beans	160mg
Olive oil	220mg
Peanuts	220mg
Sunflower seeds	530mg
Wheat germ oil	559mg
Sesame seeds	710mg
Corn oil	970mg

■ Figures from USDA nutrition database

³⁹ “Do we need to be buying plant sterols? Food Magazine. P 67. Oct/Dec 2004.

VII. Survey Result

Briefly mentioned in the methods section of this report, was the primary research that I conducted in order to determine cholesterol awareness of individuals from age groups 19-29, 30-49, and 50 and over. I selected a total of sixty individuals to participate in this study, twenty individuals for each age group (ten male, ten female). Both student and professors were selected to take this survey, all from different academic programs at the University of Rhode Island (i.e. Biology, Business, Fashion, Nutrition, Economics and English programs) in order to reduce biased in the study results. A copy of the actual survey can be found on the next page.

Cholesterol Awareness Survey
-October 2007-

(Circle one)

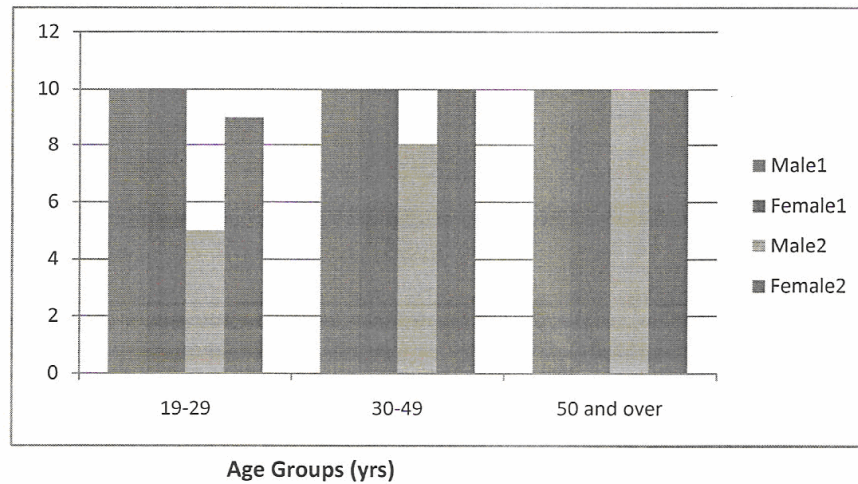
1. Do you think it is important to have your cholesterol checked? Yes No
2. Have you ever had your cholesterol checked? Yes No
3. Has a close relative ever had a heart disease or a heart attack? Yes No
4. Do you have any blood related family members with high cholesterol? Yes No
5. How often do you exercise? Never Moderately Usually Every day
8. How would you rate your diet? Poor Mediocre Good Great
9. Do you often eat foods that are high in saturated fat?
Yes Most of the time Sometimes No I don't know what Saturated fat is
10. Do you often eat foods that are high in Trans fat?
Yes Most of the time Sometimes No I don't know what Trans fat is
11. What is your gender? Male Female
12. What age category are you in? 19-29 30-49 50 and over

A. Cholesterol Awareness Survey

Age Groups	Male1	Female1	Male2	Female2
19-29	10	10	5	9
30-49	10	10	8	10
50 and over	10	10	10	10

Cholesterol Awareness Survey Results

of surveyors



*Male1/Female1: Respondents who said they thought it was important to have their cholesterol checked

*Male2/Female2: Respondents who have had their cholesterol checked

B. Family History Results

Family History Results

Male

Age Groups (yrs)	Has a close relative ever had heart disease or a heart attack?		Do you have any family members with high cholesterol?	
	Yes	No	Yes	No
19-29	50%	50%	70%	30%
30-49	20%	80%	50%	50%
50 and over	50%	50%	60%	40%

Family History Results

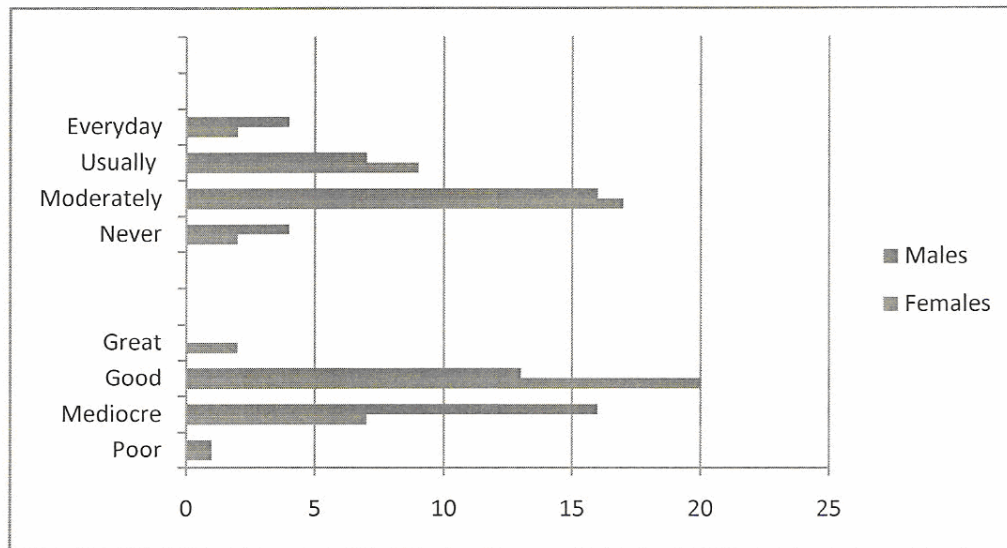
Female

Age Groups (yrs)	Has a close relative ever had heart disease or a heart attack?		Do you have any family members with high cholesterol?	
	Yes	No	Yes	No
19-29	40%	60%	60%	40%
30-49	50%	50%	60%	40%
50 and over	80%	20%	80%	20%

C. Diet & Exercise

Diet & Exercise Survey Results

		Females	Males
D I E T	Poor	1	1
	Mediocre	7	16
	Good	20	13
	Great	2	0
E X E R C I S E	Never	2	4
	Moderately	17	16
	Usually	9	7
	Everyday	2	4

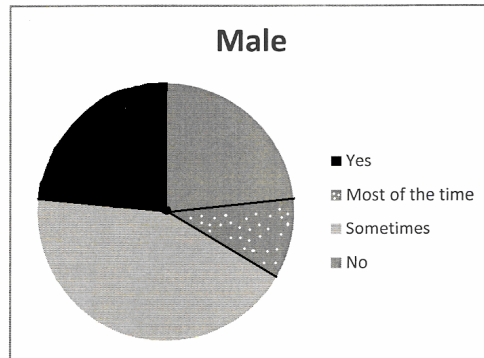


D. Saturated & Trans Fats Survey Results

Saturated Fat Survey Results

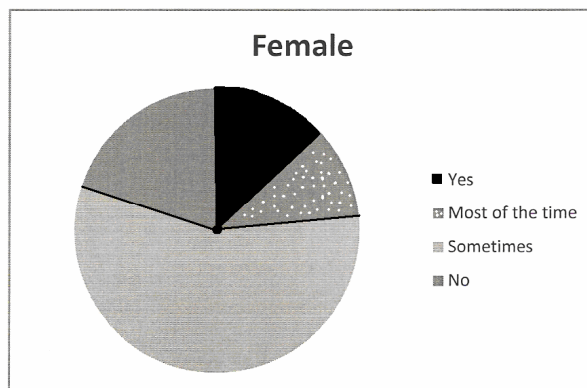
Do you Eat foods that are high in saturated fat?

	Yes	Most of the time	Sometimes	No
Male	7	3	13	7



Do you Eat foods that are high in saturated fat?

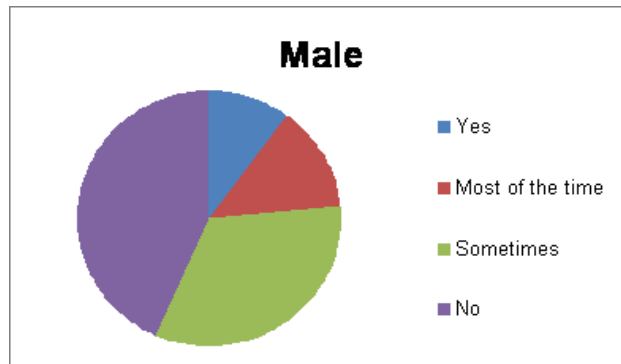
	Yes	Most of the time	Sometimes	No
Female	4	3	17	6



Trans Fats Survey Results

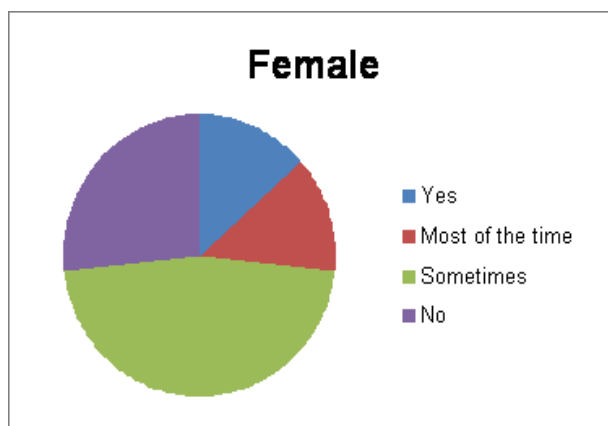
Do you eat foods that are high in trans fats?

Male	Yes	Most of the time	Sometimes	No
	3	4	10	13



Do you eat foods that are high in trans fats?

Female	Yes	Most of the time	Sometimes	No
	4	4	14	8



E. Survey Results Concluded

Based on the data collected from the surveys I conducted, it can be concluded that individuals surveyed in each age group (19-29, 30-49, 50 and over) think that it is important to get their cholesterol checked. A total of 100% of male and females indicated by the Cholesterol Awareness graph in section A of the Survey Results, indicated that they thought this was important. However, when these individuals were asked if they have ever had their cholesterol checked, 50% of the males and 90% of the females from the age group 19-29 have had their checked, 80% of males and 100% of females from the age group 30-49 have had their cholesterol checked and 100% of the male and females from the 50 year and older age group has had their cholesterol checked. Based on these survey results, I would conclude that 63% more people get their cholesterol checked at an older age (30 years or older) and that females generally get their cholesterol checked earlier than men, according to the data collected in this survey.

The American Heart Association suggests that individuals get their cholesterol checked at the age twenty or even younger. Factors such as family history of heart disease, physical inactivity, and poor dietary habits can all effect children's cholesterol levels.⁴⁰

Results from the Family History section concluded, over 50% of male and female in all age groups surveyed have a blood related family member with high cholesterol. Overall, for all age groups, 56% of males said that they viewed their diet as poor to mediocre, where 73% of females viewed their diets to be good to great. Thus, it is evident that

⁴⁰ "Common Misconceptions about Cholesterol." 27 August 2007. 17 December 2007.
<http://www.americanheart.org/presenter.jhtml?identifier=3006030>

women from 19 to over 50 years old view themselves as having a better diet than the males in these same age groups. About 80% of males and females surveyed said they exercised moderately to usually. Similarly, males and females were surveyed to consume similar amounts of Saturated Fats. The survey showed that 67% of the males from all age groups surveyed to sometimes or never eat foods high in saturated fats, where 76% of women surveyed (in all age groups combined) did not or sometimes ate foods high in saturated fats. Similar results were concluded with the consumption of foods high in trans fats by males and females in all age groups. A total of 76% of males surveyed eat foods high in trans fats either sometimes or do not consume trans fats, and 73% of women surveyed do not or sometimes consume foods high in trans fats.

After conducting this survey, I was able to gather some primary data on a sample of individual's awareness on cholesterol. This survey is only a small sample of the population, since only twenty individuals were randomly chosen from the University of Rhode Island in each age group (19-29, 30-49, and 50 and over). This survey could be used to generalize awareness of individuals at the University of Rhode Island, but should not be extended to Rhode Island residents, since some of the individuals that were surveyed are not full time residents of Rhode Island. To generalize these results to a larger population of individuals, this same survey method could be used, only with a larger sample size. For best results, the survey could also be repeated several times to test for consistency within subgroups of the population.

VIII. Conclusion

Through my research involving the cholesterol lowering effects of plant sterols and stanols, it is clear that plant sterols and stanols do help to lower LDL cholesterol in individuals. Products containing plant sterols, as previously mentioned are engineered for those individuals with high levels of cholesterol and do not serve much of an added health benefit to those who do not have high cholesterol, because it is not necessary to reduce blood cholesterol in these situations. Although, if an individual were to take a product enhanced with plant sterols, there would be no adverse side effects proven by research studies thus far.⁴¹ About 101 million American adults have been classified as having high or borderline high cholesterol concentrations, therefore it is important to promote healthy lifestyles through diet, exercise, and through the use of plant sterols and stanols. If these methods of lowering cholesterol can be implemented into a healthy lifestyle plan to start, then perhaps it will not be necessary for an individual to be prescribed a statin medication for the rest of their life. Although, in some individual cases, statins are absolutely necessary, it would be better for the individual if they were able to, lower their cholesterol the healthy way, decreasing their costs on monthly expensive prescriptions medication with the possibility of being exposed to the many adverse side effects that come with prescription drug use. Plant sterols have been proven safe by the FDA since the year 2000 and they are proven to be a healthy, natural and convenient way to improve LDL cholesterol levels and reduce the risk of heart disease in individuals.⁴²

⁴¹ Stipanuk. P 25. 2006.

⁴² Plant Sterols, Cholesterol and Heart Disease.” 2007. 12 December 2007.
<http://www.corowise.com/fastfacts.html>

IX. Works Cited

1. "Cholesterol Management Health Center." 26 August 2005. 25 October 2007.
<http://www.webmd.com/cholesterol-management/>
2. "Cholesterol Medication." 2007. 3 December 2007.
<http://www.americanheart.org/presenter.jhtml?identifier=3044771>
3. "Cholesterol." 2007. 6 November 2007. <http://www.americanheart.org/presenter.jhtml?identifier=4488>
4. "Cholesterol: The best foods to lower your cholesterol and protect your heart." 10 May 2006. 12 November 2007. <http://www.mayoclinic.com/health/cholesterol/CL00002>
5. "Definition of dietary fiber." 10 December 2007. 11 December 2007
<http://www.dietaryfiberfood.com/dietary-fiber.php>
6. "Dietary Fiber is Still in Style." March/April 1999. 17 December 2007.
<http://www.ific.org/foodinsight/1999/ma/fiberfi299.cfm>
7. "Do we need to be buying plant sterols?" Food Magazine. p 67. Oct/Dec 2004.
8. "FDA Authorizes new coronary heart disease health claim for plant sterols and plant stanol esters." 5 September 2000. 29 October 2007. <http://www.fda.gov/bbs/topics/ANSWERS/ANS01033.html>
9. "Foods Enriched with Plant Sterols." 2007. 2 December 2007. <http://www.corowise.com/fastfacts.html>
10. "Functional Food Fact Sheet." April 2003. 2 October 2007.
<http://www.ific.org/publications/factsheet/sterols/cfm>
11. "Heart Disease and Stroke Statistics-2006 Update." 2006. 3 November 2007.
<http://circ.ahajournals.org/cgi/content/full/113/6/e85#SEC2>.
12. "Heart Smarts for Women." Fall 2003. 31 October 2007.
http://www.kraftfoods.com/kf/Foodandfamily/fall_2003/healthyliving/
13. "Heredity as a Risk Factor." 2007. 2 December 2007.
<http://www.americanheart.org/presenter.jhtml?identifier=4610>
14. Herron-Rubin, Kristin, Interview 10 November 2007.
15. "How does physical activity affect cholesterol?" 2007. 2 December 2007.
<http://www.americanheart.org/presenter.jhtml?identifier=4488>
16. Katan MB et al. "Efficacy and safety of plant stanols and sterols in the management of blood cholesterol levels." August 2003. 1 November 2007.
17. Lofgren, Ingrid. Interview. 8 November 2007.
18. Moruise, Kgomo G, et al. "Phytosterols/Stanol Lower Cholesterol Concentrations in Familial Hypercholesterolemia Subjects." Journal of the American College of Nutrition. Vol 25.no.1. Pp. 41-42, 45-47. 2006.
19. "National Institutes of Health." June 2005. 3 November 2007.
<http://www.nhlbi.nih.gov/health/public/heart/chol/wyntk.htm>

20. "Phytostertol/stanol enriched foods: National Heart Foundation of Australia. August 2007. 17 December 2007.
http://www.heartfoundation.org.au/document/NHF/HF_Phytosterol_Stanol_QA_General_2007_Aug_FIN_AL.pdf
21. "Plant Sterols, Cholesterol and Heart Disease." 2007. 12 December 2007.
<http://www.corowise.com/fastfacts.html>
22. "Rollout: September's best new products." September 2007. 31 October 2007.
<http://www.foodprocessing.com/articles/2007/219.html>
23. "Rollout: The best of April's new food products." April 2005. 31 October 2007.
<http://www.foodprocessing.com/articles/2005/291.html>
24. Schaefer, Ernst. "Was the Statin Prescription Right in the First Place?" Health and Nutrition Newsletter, Tufts University. August 2003. 8 December 2007. <http://healthletter.tufts.edu/issues/2003-08/statin.html>
25. "Start Roughing it!" 2007. 30 October 2007. <http://www.hsph.harvard.edu/nutritionsource/fiber.html>.
26. Stipanuk, Martha H. Biochemical Physiological and Molecular Aspects of Human Nutrition. Saunders Publisher. 2nd Edition. Pp.24-25. 2006.
27. "The Baycol Recall-what it means" 13 August 2001. 3 September 2007.
<http://heartdisease.about.com/library/weekly/aa081301a.htm>
28. "The Power of Natural Plant Sterols." 2007. 23 September 2007.
<http://www.webmd.com/content/article/134/119063.htm>
29. Valsta, L.M. et al. British Journal of Nutrition. 92. pp. 671-678. 2004
30. "What about Cholesterol and Diet?" 2007. 6 November 2007.
<http://www.americanheart.org/presenter.jhtml?identifier=4488>
31. "What is dietary fiber?" 2007. 2 December 2007.
<http://www.americanheart.org/presenter.jhtml?identifier=4574>